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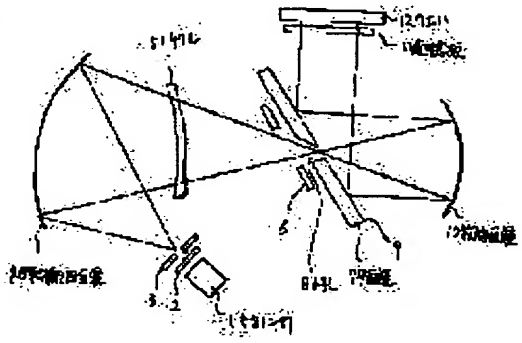
(54) OPTICAL SYSTEM FOR LSI MANUFACTURING CONTRACTION PROJECTION ALIGNER BY LIGHT

(57)Abstract:
PURPOSE: To obtain a mirror type stepper in which a short wavelength ultraviolet ray is used as a light source and which has a deep focal depth, a wide exposure area and a large numerical aperture.
CONSTITUTION: A light source is mounted at one focal point of a rotational elliptical concave mirror, the small hole 8 of the mirror 7 is mounted at the other focal point, and the hole 8 also becomes a focal point of a parabolic mirror 10. A high coherent light is used as a light source thereby to deepen a focal depth, to remove various aberrations and to improve an effective numerical aperture. Further, a reticle image is increased larger than an image on a wafer and the width of the wavelength of an illumination light is increased thereby to prevent deterioration of the image due to the use of the coherent light. In this case, its resolution is improved when transparent liquid is filled between optical systems.



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* NOTICES *

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CLAIMS

[Claim(s)]
[Claim 1] Optical system of the LSI manufacture cutback projection aligner characterized by having been in agreement in the stoma which has the exposure device concentrated on one point ahead of reticle, and a plane mirror has in one point which the light concentrates, having installed the plane mirror, and installing a concave mirror in the confrontation of the mirror plane of the plane mirror.
[Claim 2] LSI manufacture cutback projection aligner of the structure which fills the space between optical system with a transparent liquid, and is carrying out circulation ** of the transparent liquid according to claim 1.

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DETAILED DESCRIPTION

[Detailed Description of the Invention]
[0001] [Field of the invention on industry] this invention relates to the optical system of the LSI manufacture cutback projection aligner (stepper) by mirror type light.
[0002] There is a stepper a mirror type actual size package projection aligner and lens type conventionally [[conventional technical]].
[0003] -- since only the linear image of the rate of actual size is obtained in the optical system of the mirror type actual size package projection aligner of the [Problem(s) to be Solved by the Invention] former, the precision alignment of a mask image is difficult, the effect by dust is large, and it is difficult to correct all defects -- etc. -- there was a problem.
[0004] the little of the transparence matter usable on a lens in a stepper conventional lens type at ultraviolet C, and transparency -- low -- moreover, there was a problem of the endurance of a lens.
[0005] This invention has the optical system of the mirror type which can use ultraviolet C, and aims at offering the stepper which has the deep depth of focus in high resolution and a large exposure area.
[0006] In order to attain the [The means for solving a technical problem] above-mentioned object, it sets to the optical system of this invention stepper. It is in agreement with one ****** of the light in the stoma which a plane mirror has, and a plane mirror is installed. the high coherent light of a comparatively large wavelength region -- the light source -- carrying out -- a condensing concave mirror -- one ahead of reticle -- the inside of ** -- putting -- [0007] -- [0008] A concave mirror is installed in the confrontation of the mirror plane of the plane mirror, and it is made in agreement [the focus of the concave mirror and the stoma of a plane mirror].
[0009] a very thin transparence aperture plate vertical to the parallel ray to which reticle is irradiated, and the light from the light source passes the stoma of a plane mirror, serves as a parallel ray mostly with a concave mirror, and reflects and advances with the same plane mirror -- installing -- [0010] -- approach the transparence aperture plate extremely, install a wafer, and carry out cutback image formation of the reticle image on the wafer.
[0011] And reticle is produced on the curved surface which amends image surface curvature.
[0012] the space between optical system -- a transparent liquid -- filling -- the transparent liquid -- circulation **** -- it is effective by the reason things carry out a postscript.
[0013] -- the light which penetrated [operation] reticle -- high -- if it is coherent and the aperture D and the focal distance of wavelength lambda and a condensing concave mirror are set to f, it will concentrate on the stoma of the plane mirror which has 84.6% of the total quantity of light ahead of reticle in the radius of gamma=1.22lambdaf/D. The perimeter presents the diffraction figure of reticle.
[0014] Since reticle and a transparence aperture plate are made of synthetic quartz in this invention, a front face can be ground smoothly and the effect of the front face by high coherent light activity is small.
[0015] In this invention, since it is isolated with the external world that it is also at a transparence aperture, the convection current of air has prevented trespass of dust few again. If whole this invention is brought close to a vacuum, the convection current of air and the effect of dust will become small.
[0016] objection -- the space between the Miller optical system -- a transparent liquid -- filling -- the transparent liquid -- circulation **** -- by things, the effect of the front face of reticle and a transparence aperture plate becomes small, and the effect of dust becomes small. And change is prevented for the rate of optical refraction by the temperature rise for light to be absorbed by the transparent liquid.
[0017] Since it is installed at [a transparence aperture is very thin and] right angles to the light reflected with the concave mirror and the plane mirror, don't produce chromatic aberration.
[0018] In this invention, since the electrostatic precipitator is installed in the perimeter of the stoma of a

plate mirror between a plate mirror and reticle, the dust in a stepper was removed and trespass of the dust to the Miller optical system which leads the stoma of a plate mirror has been prevented.
[0019] In this invention, since it is so good that the image pattern on reticle has many transparent parts, it is necessary to take into consideration in image formation. It may be better to enforce reversal of the image of a photoresist depending on an image pattern.
[0020] Although the deficit section corresponding to [in LSI manufactured by this invention stepper] the stoma of a plate mirror to a core exists, since a stoma is the diameter of about 1mm, there is no effect to an LSI degree of integration. If the quantity of light of the light source can be enlarged, of course, the diameter of a stoma can be set up smaller.
[0021] If a [example] example is explained with reference to a drawing, in drawing 1 , it will install in the optical path of the light from xenon LGT 1 in xenon LGT 1, a filter 2, a slit 3, the spheroid concave mirror 4, reticle 5, the stoma 8 of a plane mirror 7, a parabolic mirror 10, a plane mirror 7, the transparence aperture plate 11, a wafer 12, and this sequence, and the stoma 8 of a plane mirror 7 will be installed in one focus of a spheroid concave mirror at a slit 3 and another focus. Moreover, the stoma 8 also serves as a focus of a parabolic mirror 10 simultaneously. At this time, the mirror plane 9 of a plane mirror 7 faces a parabolic mirror 10, and is installed, and the electrostatic precipitator 6 is attached in the perimeter of a stoma 8.
[0022] Some kinds of gas, such as AgammaF and KgammaF, is mixed instead of xenon LGT 1, and there is an example which made the oscillation **** excimer laser the light source for oscillation wavelength.
[0023] There is an example which used the lens for aberration amendment instead of the transparence aperture plate 11.
[0024] There is an example which used other concave mirrors, such as a spherical mirror and a hyperboloid mirror, instead of the parabolic mirror 10.
[0025] In the example shown in drawing 2 , the space between optical system is filled with a transparent liquid, and circulation ** of the transparent liquid is carried out. Reticle 5 is dipped in the tub 13 which fills a transparent liquid.
[0026] Since [effectiveness of design] this invention is constituted as explained above, it does so effectiveness which is indicated below.
[0027] Since high coherent light is used for the reticle exposure light source and it is very among ** in one ahead of reticle with a spheroid concave mirror, if the aperture D and the focal distance of wavelength lambda and a spheroid concave mirror are set to f, it will be concentrated on the stoma of the plane mirror which has 84.6% of the total quantity of light ahead of reticle in the radius of gamma=1.22 f/D. Although the perimeter of a stoma serves as a diffraction figure of reticle, since the core of a stoma serves as the very high quantity of light as compared with the FUCHI section of the shape of a circumference ring of the width of face of the wavelength of the light of a stoma, the rate which light passes the FUCHI section of a stoma and diffraction produces is very small. Therefore, lowering of the resolution by light passing a stoma is very small. This effectiveness becomes large as a stoma approaches the radius of gamma=1.22lambdaf/D.
[0028] As for the great portion of light which reaches each point of the image on the front face of a wafer, since it is reflected in the very small range in which a parabolic mirror corresponds, the depth of focus has also become and aberration other than image surface curvature or image surface distortion has become very small.
[0029] moreover -- since the great portion of light which reaches each point of the image on the front face of a wafer is reflected in the very small range in which a parabolic mirror corresponds -- count of a parabolic mirror -- effective numerical aperture becomes large from top numerical aperture.
[0030] Since it is the type reduced to about [of a reticle image] 1/10 although speckle noise etc. appears in the diffraction development of a reticle image when high coherent light is used for the exposure light source, even if it uses high coherent light for the light source that a large reticle image pattern can be taken and by taking large wavelength **** since there is no chromatic aberration, there is no degradation of an image.
[0031] By this invention stepper, as for about 0.35 numerical aperture about exposure area phi30mm and on count, and (effective numerical aperture, size) is obtained more.
[0032] Since mirror type optical system is being used for this invention, ultraviolet C can be used for it from a lens type optical-system activity stepper.
[0033] When the refractive index of lambda and a transparent liquid is set to eta for the wavelength of light by filling the space between optical system with a transparent liquid, there is the same effectiveness using the light of lambda/eta.

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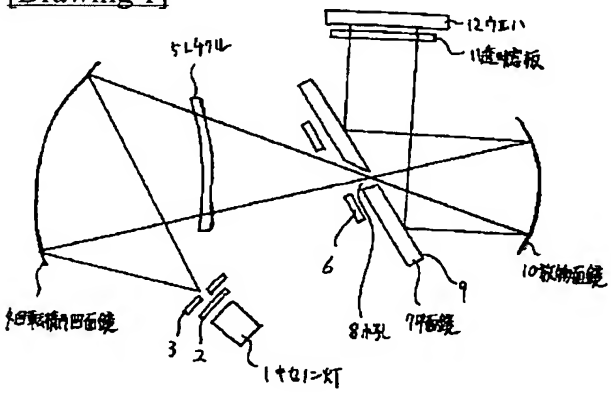
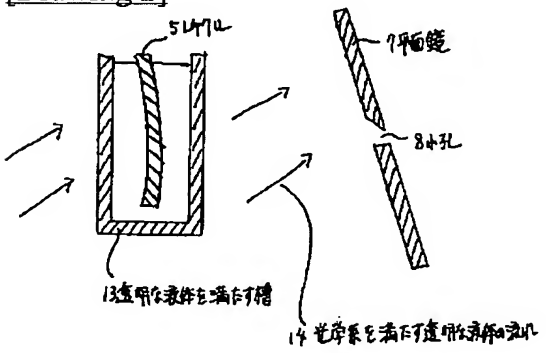
DRAWINGS

[Drawing 1]



[Drawing 2]



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